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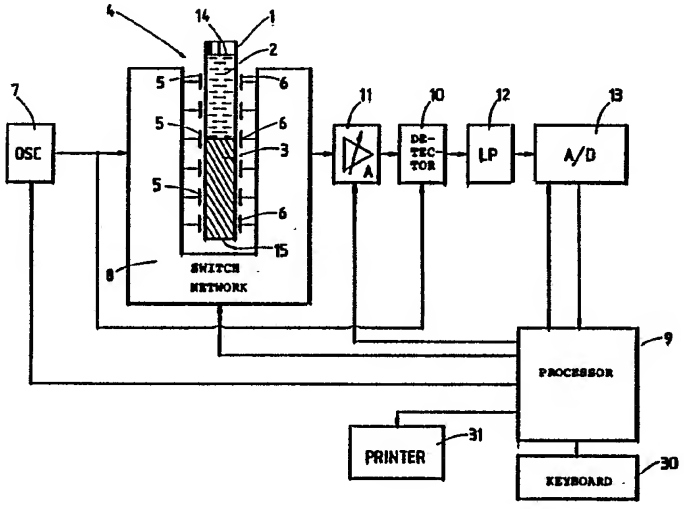
(54) Title: A METHOD AND DEVICE FOR DETERMINING THE SEDIMENTATION RATE OF BLOOD

(57) Abstract

A method of determining the sedimentation rate of blood, in which a so-called blood sedimentation tube is filled with whole blood which is allowed to settle for a period of one hour, whereafter the height of a plasma column above the blood sediment is read-off. The invention is characterized by inserting the test tube (1) into a reading location (4) in which a plurality of electrodes are disposed along the vertical extension of the tube (1); supplying to the electrodes a signal of varying voltage; determining the impedance of the blood (2, 3) present in the tube (1) between pairs of electrodes (5, 6); determining the location along the vertical extension of the tube (1) at which a change in impedance has occured, using herefor the fact that an impedance difference prevails between plasma (2) and blood sediment (3) respectively; and by determining the vertical distance from the aforesaid location to the upper surface (14) of the plasma column (2). The invention also relates to apparatus for carrying out the method.



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A Method and Device for Determining the Sedimentation Rate of Blood

The present invention relates to a method and to a device for determining the sedimentation rate of blood.

The determination of the blood sedimentation rate, or erythrocyte sedimentation rate, is the most common of blood tests carried out. In different conditions of sickness or disease, the blood cells tend to agglomerate in the so-called rouleau formation of erythrocytes. If the blood is prevented from coagulating, the blood cells will therewith sink more rapidly down to the bottom of an upstanding tube. The supernatant liquid consists of plasma and the height or thickness of this clear layer in millimeters provides a value of the sedimentation rate. This value is read-off precisely one hour after having placed the tube in a measuring stand. A very large number of blood sedimentation tests are carried out each day in hospitals, laboratories and health care centres, and with each test it is necessary to start a clock which rings after sixty minutes from the time of having been started, whereupon it is necessary to interrupt any other work that is being carried out and read-off the value of the sedimentation rate. This greatly disturbs the process of other activities and consequently there has long been an urgent desire for means which will enable the sedimentation rate values to be read-off automatically.

The Swedish Patent Specification No. 8009126-7 describes a method of obtaining an automatic indication of the interface between plasma and blood sediment after one hour. According to this patent specification, there is placed in a sedimentation test tube a body which absorbs blood and plasma and swells as a result of this absorption:

The body has a density which lies between the density of blood sediment and plasma and will therefore float at said interface layer. The body is configured so that after one hour, it will have swollen to such an extent as to fasten in the test tube.

The drawback with this known method, however, is that it is necessary to place the body in the test tube, and, inter alia, present standar-

dized routines for determining the sedimentation rate of blood have been changed accordingly.

There has long been an urgent desire to read-off the values of blood sedimentation rates fully automatically. It is obvious that a method which retains present-day routines and with which no devices other than the actual test tube itself come into contact with the blood is to be preferred.

The present invention provides such a method, by means of which reading of blood sedimentation rates can be automated.

The present invention thus relates to a method for determining the sedimentation rate of blood, in which a so-called blood sedimentation tube is filled with whole blood, which is allowed to settle for one hour, whereafter the height of a plasma column above the blood sediment is read-off, said method being characterized by inserting the blood sedimentation tube into a reading location in which a plurality of electrodes are disposed along the vertical extension of the tube, by applying a signal of varying voltage to the electrodes, by determining the impedance of the blood present in the tube between pairs of electrodes, with the aid of a detector; by determining the location along the length of the tube at which a change in impedance takes place while utilizing the fact that an impedance difference prevails between plasma and blood sediment, and by determining the height or distance from said location to the upper surface of the plasma column.

The invention also relates to apparatus of the kind described in the preamble of Claim 9 and having the characterizing features set forth in the characterizing clause of said Claim.

The invention will now be described in more detail with reference to exemplifying embodiments thereof illustrated in the accompanying drawings, in which

- Figure 1 is a block schematic of apparatus according to a first embodiment of the invention;

- Figure 2 illustrates a pattern of electrodes;

- Figure 3 illustrates a second embodiment of the invention;

- Figure 4 illustrates an output signal obtained in accordance with a first measuring principle; and

- Figure 5 illustrates an output signal obtained in accordance with a second measuring principle.

Figure 1 illustrates apparatus for carrying out the inventive method. In Figure 1, the reference 1 identifies a so-called blood sedimentation tube, which is normally a glass or plastic tube having a length of 200 mm, a diameter of 10 mm and a wall thickness of 0.5 mm.

The reference 2 identifies plasma and the reference 3 identifies blood sediment. A reading location or reading station is generally referenced 4. The apparatus may include solely one reading location to which mutually different test tubes are moved automatically with the aid of known devices, which is standard routine when carrying out automatic test analyses within the medical field, or may comprise one reading location or station for each tube.

The reading location includes electrodes 5, 6 which are disposed along the length extension of a tube 1 inserted in the reading location. The apparatus also includes an oscillator 7 which functions to produce a signal which is applied successively to the electrodes 5.

Also included is a so-called switch network 8 or the like, which includes a number of electronic switches. The switching network 8 is constructed to connect one or more electrodes 5 at a time to the oscillator 7 in a successive order, in response to instructions from a control unit or data processor 9. The switch network 8 is also constructed to connect, at the same time, one or more electrodes 6 to a detector 10 included in the apparatus.

The oscillator 7 is intended to produce a signal having a frequency between 100 Hz and 10 kHz, preferably about 1 kHz. However, any

suitable frequency whatsoever may be used. The electrodes may have a drive voltage of 50 mV, for instance. The oscillator signal is preferably a square-wave signal.

According to one preferred embodiment, the DC-component of the signal is equal to 0 volts, so as not to affect the blood.

The oscillator 7 also delivers the signal to the detector 10, which is a synchronous detector.

The detector 10 is intended to measure the impedance between pairs of electrodes. In the case of the Figure 1 embodiment, the impedance is measured between mutually opposing electrodes 5, 6 in relation to the tube 1.

The present invention is based on the understanding that whole blood, plasma and blood sediment exhibit mutually different electrical properties of a magnitude such as to enable the impedance difference to be measured in order to determine the presence of the interface between blood sediment and plasma.

The inventive method will now be described with reference to Figure 1.

A blood sedimentation tube is present in or is inserted into the reading location. After one hour has passed from the time of taking the blood sample, the data processor begins a measuring cycle.

The data processor controls the switch network 8 such that, for instance, the oscillator signal is applied to the uppermost electrode 5. The electrode 6 positioned on the opposite side of the tube is connected by the switch network 8 to an amplifier 11, which amplifies the signal of the receiver electrode 6. This amplified signal is detected in the detector 10 and is low-pass filtered in a low-pass filter 12. The amplitude of the signals arriving from the low-pass filter constitute a measurement of the impedance across the plasma column 2.

As before mentioned, the detector 10 is a synchronous detector intended

to maximize system sensitivity or response. The low-pass filter 12 may be given a large time constant, for instance a constant of several seconds. The combination of a synchronous detector and a narrow-band low-pass filter enables very long measuring signals to be measured. The low-pass filtered analogue signal is digitalized in an A/D-converter 13 and delivered to the data processor 9.

The detector thus compares the signal applied on an electrode to the signal received by the receiver electrode.

The switch network is able to connect the electrodes in any desired sequence.

It is preferred, however, that subsequent to completing the aforesaid first measurement process, the next electrode 5 in line, counting from the top of the electrode array, is connected to the oscillator and the opposing electrode 6 is connected to the amplifier 11. There is then obtained a new value after the A/D-converter 13.

When the third electrode 5 from the top of said electrode array is used to measure impedance together with the opposite electrode 6, there will be established a change in impedance will be established in comparision with the impedance exhibited by the plasma 2, since both plasma and blood sediment influence the measuring process.

When the electrodes 5, 6 further down the electrode array are used for measuring purposes, these electrodes will indicate an impedance across the blood sediment which differs from the two impedances mentioned above.

The changes that occur will depend on which component or components in the impedance are measured and evaluated. For instance, both series and parallel resistances across the sample can be measured, or series or parallel capacitances.

According to one preferred embodiment, the detector is arranged to measure the capacitance immediately across pairs of electrodes 5, 6.

Naturally, the accuracy of the method is contingent on the size of the electrodes 5, 6. The electrodes shown in Figure 1 have been purposely enlarged for the sake of clarity.

Figure 2 is a top view of a preferred electrode pattern or array. The electrodes 5, 6 are mutually parallel and are positioned so as to extend along the longitudinal axis of a blood sedimentation test tube 1 inserted in the measuring location. The longitudinal axis of the electrodes extend perpendicularly to the longitudinal axis of the tube.

According to one preferred embodiment, the electrodes are placed equidistant from one another, with a centre distance of 1 mm. This provides very good resolution, with an accuracy of 1 mm, which is the accuracy applied when reading the sedimentation value manually. For instance, the electrode pattern may be configured so that the centre distance l of the electrodes shown in Figure 2 is 1 mm, as before mentioned, wherein the distance between the electrodes c is approximately 0.3 mm and the vertical extension a of the electrodes is approximately 0.7 mm. The width b of the electrodes may be approximately 5 mm.

The total vertical extension of the electrode array L may, of course, correspond to the vertical extension or length of a blood sedimentation tube, i.e. 200 mm although said total vertical extension is preferably longer, so that the electrode array will include the range within which blood sedimentation values occur.

The electrode pattern or array may, for instance, be etched on one side of a double-sided, flexible laminate, with connecting wires to each electrode on the other side of the laminate.

The distance from each of the electrodes to the upper surface 14 of the sample is known, because the length of the tube is known, because the position of the bottom surface 15 relative to the electrodes is known, and because the tube is filled to a predetermined level. The position of the upper surface of the sample can, of course, be determined by the present capacitive method, with the aid of electrodes positioned in the region of the upper surface of the sample.

Subsequent to having noted an impedance change after a measuring cycle, the location of the impedance change is known, because the data processor has registered at which electrode or electrodes the change has taken place.

In this regard, the data processor is programmed to calculate the height or vertical distance from the location at which the impedance change occurred, i.e. the location of the interface between blood sediment and plasma, to the upper surface of the plasma column. This distance, i.e. the height of the plasma column, is the blood sedimentation value, as before mentioned.

This value is stored in the data processor.

Figure 4 illustrates schematically a curve which shows the signal amplitude obtained from the A/D-converter against the position of respective electrodes along the tube.

Thus, upon completion of a measuring process in which pairs of electrodes have been connected successively, a number of discrete measurement values are found stored in the data processor. Figure 4 illustrates the continuous curves through these discrete measurement values. As will be seen from the curve, there is a clear change in amplitude at the interface. The data processor is intended to establish the location of the interface along the tube, for instance by interpolation or inflection-point determination.

In the described embodiment, one electrode 5 and one electrode 6 have been used at a time. However, several electrodes 5 and several electrodes 6 can be used in one and the same measuring process.

In the aforegoing, there has been described a first embodiment in which the impedance is measured transversely across the sample with the aid of mutually opposing electrodes.

Figure 3 is a schematic illustration of a second embodiment in which of the electronic circuits used only one switch network 80, correspon-

ding to the switch network 8, is shown.

The electrodes 16-21 have been purposely enlarged for illustration purposes, similar to the case in Figure 1.

According to the Figure 2 embodiment, there is preferably used an electrode pattern or array with associated text.

According to this second embodiment, all electrodes 16-21 are placed on one side of the tube 1. In this case, the switch network 80 is intended to connect successively one or more electrodes at a time to the oscillator 7, in response to instructions from the data processor, and to connect to the detector 10, via the amplifier 11, those two electrodes which surround the electrode connected to the oscillator.

For instance, when the electrode 17 is connected to the oscillator, the electrodes 16 and 18 are connected to the detector.

In this embodiment, the detector is intended to compare the signal between two electrode pairs, i.e. 16, 17 and 17, 18 respectively. Thus, there is effected a difference-measuring process. The amplitude of the signal obtained from the A/D-converter will therefore be constant and low, for instance equal to zero, when the measuring electrodes measure the same part of the sample.

When the interface between blood sediment and plasma lies within the measuring range of the measuring electrodes, the signals from the respective electrode pairs 16, 17; 17, 18 will be different, and hence the signal obtained from the A/D-converter will have an amplitude which corresponds to the difference between said signals.

According to this second embodiment, several electrodes may be supplied with a signal and several electrodes may be used on both sides of the electrodes supplied with said signal.

Figure 5 illustrates schematically a curve which shows the signal amplitude obtained from the A/D-converter against positions along a blood sedimentation tube, in a manner corresponding to that illustrated

in Figure 4. The interface is thus found at the amplitude maximum.

According to one preferred method, the apparatus is calibrated immediately after filling the tube with whole blood. The impedance which then prevails is used later as a reference when measurements are taken on blood sediment and plasma respectively.

A keyboard 30 or the like is connected to the data processor 9, so that data, etc. relating to the patient can be entered into the processor. The data processor will preferably include a clock which shows the time and the date concerned.

The sedimentation rate of a blood sample can, for instance, be determined in the following manner.

A blood sedimentation tube is filled with whole blood, by a nurse. The nurse places the tube in the apparatus and enters the personal identification number of the patient into the data processor through the keyboard. A sensor (not shown), preferably a photocell, may be positioned at the reading location, in order to initiate the time measuring process. Alternatively, the time measuring process may be initiated as a result of entering the personal identification number of the patient in the data processor.

Subsequent to the lapse of one hour from the time of initiating the time measuring process, the data processor instructs the apparatus to detect the position of the interface, as before described. The sedimentation value is stored in the data processor, together with the personal identification number of the patient.

A display and/or a printer 31 may be connected to the data processor.

The data processor is preferably programmed to print successively completed blood sedimentation tests through the printer 31.

The data processor may also be programmed to store the blood sedimentation values for short or longer periods of time, for instance for one or more weeks, wherein the data processor can be instructed

through the keyboard to print-out a series of blood sedimentation values for one and the same patient. Naturally, it is also possible to program the data processor so that the printer will illustrate variations in the blood sedimentation value with time, in a graphic form.

Although the invention has been described in the aforegoing with reference to the number of embodiments thereof, it will be obvious that modifications can be made. For instance, measuring can be effected at two or more different frequencies in successive stages. Furthermore, the electrodes may be arranged in a different pattern or array.

The present invention is therefore not to be considered restricted to the aforedescribed embodiments, since variations can be made within the scope of the following Claims.

Claims

1. A method for determining the sedimentation rate of blood, in which a so-called blood sedimentation test tube is filled with whole blood which is allowed to settle over a period of one hour, whereafter the height of a plasma column above the blood sediment is read-off, c h a r a c t e r i z e d by inserting the test tube (1) into a reading location (4) in which a plurality of electrodes (5, 6; 16-21) are disposed along the vertical extension of the tube (1); supplying to the electrodes a signal of varying voltage; determining the impedance of the blood (2, 3) present in the tube (1) between pairs of electrodes (5, 6; 17, 16; 17, 18) with the aid of a detector (10); determining the location along the vertical extension of the tube (1) at which a change in impedance has occurred, using herefor the fact that an impedance difference prevails between plasma (2) and blood sediment (3) respectively; and by determining the vertical distance from said location to the upper surface (14) of the plasma column (2).

2. A method according to Claim 1, c h a r a c t e r i z e d by measuring the capacitance across pairs (5, 6; 17, 16; 17; 18) of electrodes with the aid of said detector (10).

3. A method according to Claim 1 or 2, c h a r a c t e r i z e d by supplying the electrodes (5; 17-20) in successive order with a signal having a frequency of between 100 Hz and 10 kHz, preferably about 1 kHz.

4. A method according to Claim 3, c h a r a c t e r i z e d in that the DC-components of the signal is 0 volt.

5. A method according to Claim 1, 2, 3 or 4, c h a r a c t e r i z e d by positioning the electrodes (5, 6; 17-21) in mutual parallel relationship along the tube (1) such that said electrodes extend perpendicularly to the longitudinal axis of said tube (1).

6. A method according to Claim 1, 2, 3, 4 or 5, c h a r a c t e r i z e d by positioning the electrodes (16-21) on solely one side of the tube (1); by supplying said signal in a successive order to one

or more electrodes (17-20) at a time; and by measuring the impedance between the electrode or electrodes supplied with said signal and the electrodes located on both sides of said electrode or electrodes.

7. A method accopding to Claikm 1, 2, 3, 4 or 5, c h a r a c t e r i z e d by positioning the electrodes (5, 6) on mutually opposite sides of the tube (1); by supplying said signal in a successive order to one or more electrodes (5) at a time; and by measuring the impedance between the electrode or electrodes (5) supplied with said signal and one or more electrodes (6) on the opposite side of the tube (1).

8. A method according to any one of the preceding Claims, c h a r a c t e r i z e d by filling a blood sedimentation tube (1) with whole blood and measuring the impedance of the whole blood immediately after having filled the tube, and using the measurement value obtained as a reference value during subsequent measurement of the impedance over the plasma and blood sediment respectively.

9. Apparatus for determining the sedimentation rate of blood, where a so-called blood sedimentation test tube is filled with whole blood which is allowed to settle over a period of one hour, and thereafter measuring the height of a plasma column above the blood sediment, c h a r a c t e r i z e d in that the apparatus includes a reading location or station (4), in which a blood sedimentation tube (1) filled with blood is intended to be inserted to a position in which electrodes (5, 6; 16-21) present in said reading location (4) are disposed along the longitudinal axis of an inserted tube (1); in that an oscillator (7) and a so-called switch network (8; 80) or a corresponding device is intended to supply said electrodes (5; 17-20) with a signal of varying voltage; in that a detector (10) is provided for measuring the impedance between pairs of electrodes (5, 6; 17, 16; 17, 18); in that an evaluating circuit, preferably a data processor (9), is provided for establishing at which electrode or at which electrodes a change in impedance takes place, where the fact that an impedance difference prevails between plasma and blood sediment respectively is utilized; and in that said data processor (9) is intended to calculate the vertical extension from the position at

which an impedance change occurs to the upper surface (4) of the plasma column (2).

10. Apparatus according to Claim 9, c h a r a c t e r i z e d in that the detector (10) is intended to measure the capacitance over pairs of electrodes (5, 6; 17, 16; 17, 18).

11. Apparatus according to Claim 9 or 10, c h a r a c t e r i z e d in that the switch network (8; 80) or the like is intended to connect in successive order one or more electrodes (5; 17-20) to said oscillator (7) at a time; and in that the oscillator (7) produces a signal having a frequency of between 100 Hz and 10 kHz, preferably about 1 kHz.

12. Apparatus according to Claim 9, 10 or 11, c h a r a c t e r i z e d in that the electrodes (5, 6; 16-21) are mutually parallel and are displaced along a blood sedimentation tube inserted in said reading location such as to extend perpendicularly to the longitudinal axis of the tube.

13. Apparatus according to Claim 9, 10, 11 or 12, c h a r a c t e r i z e d in that the electrodes (16-21) are placed on only one side of an inserted tube (1); and in that the switch network (80) or the like is intended to connect one or more electrodes (17-20) to said oscillator (7) at a time and to connect to said detector (10) one or more of those electrodes which surround the electrode or electrodes connected to the oscillator (7).

14. Apparatus according to Claim 9, 10, 11 or 12, c h a r a c t e r i z e d in that the electrodes (5, 6) are positioned on mutually opposite sides of an inserted tube (1); and in that the switch network (8) or the like is intended to connect one or more electrodes (5) to said oscillator (7) at a time and to connect to said connector (10) one or more electrodes (6) present on the opposite side of the tube.

15. Apparatus according to any one of Claims 9-14, c h a r a c - t e r i z e d in that the electrodes (5, 6; 16-21) are positioned

mutually equidistantly with a centre distance of 1 mm between mutually adjacent electrodes.

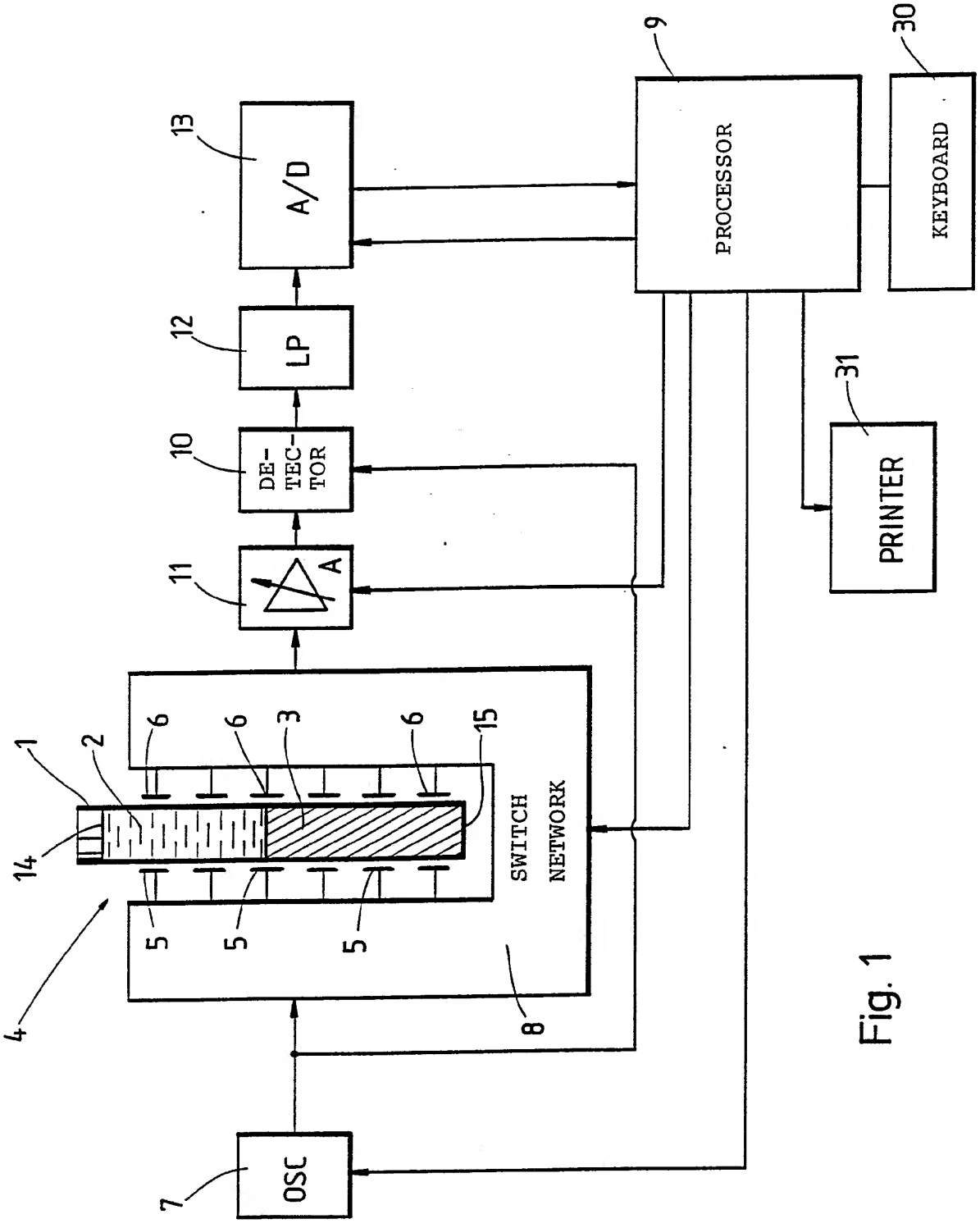
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Fig. 1

Fig. 2

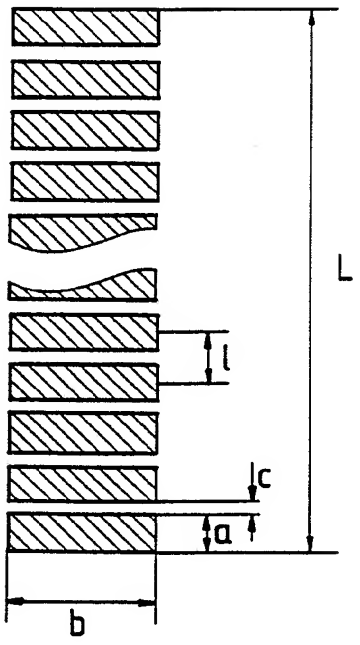


Fig. 4

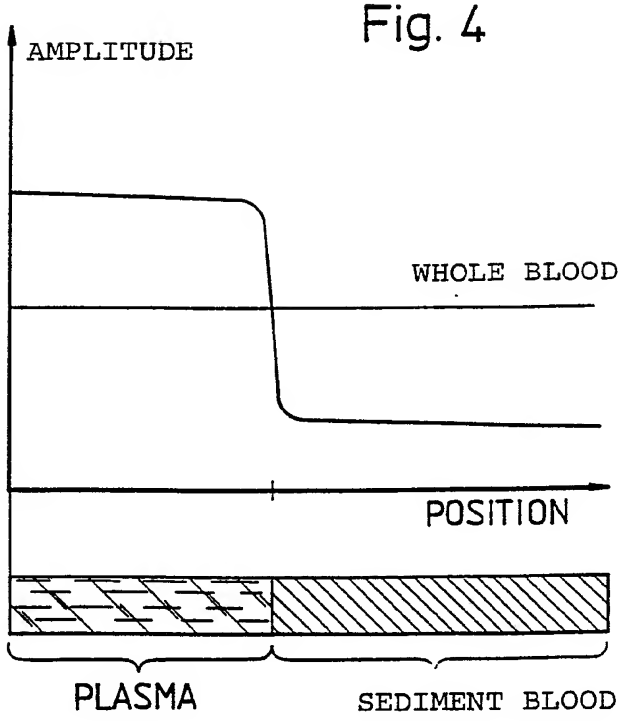


Fig. 3

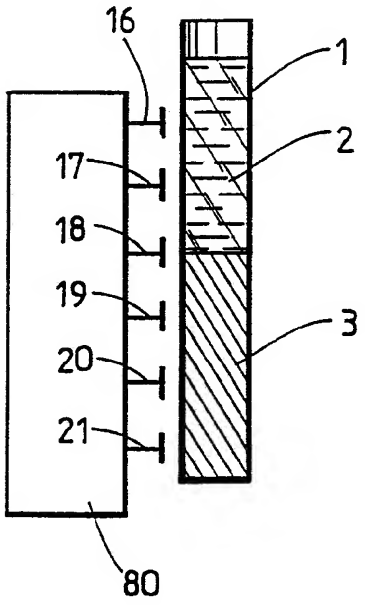
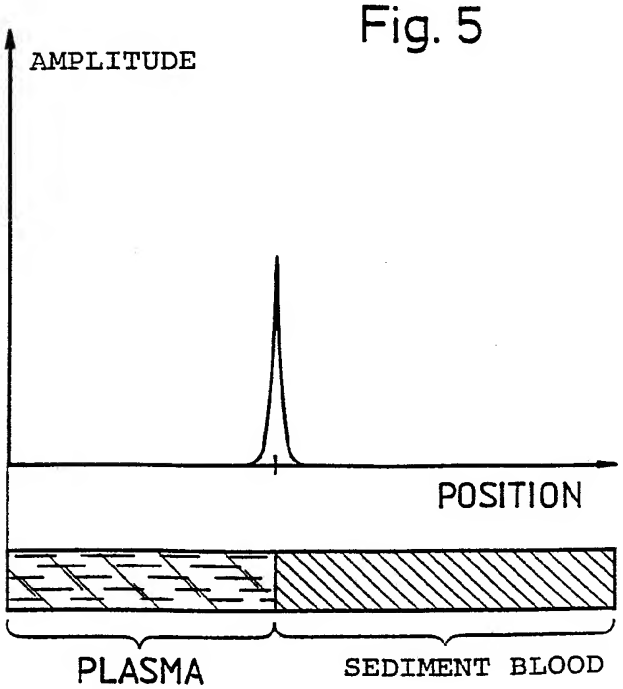


Fig. 5



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00824

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, ind.cate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: G 01 N 15/05

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	G 01 N

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	DE, B2, 2702557 (LABORA MANNHEIM GMBH FÜR LABORTECHNIK) 8 February 1979, see column 3, line 60 - column 4, line 23 --	1-15
A	US, A, 3254527 (HANS GÜNTER NÖLLER) 7 June 1966, see column 1, line 40 - line 72 --	1-15

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* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
8th March 1991	1991 -03- 13
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Bertil Dahl

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 90/00824

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 91-01-31
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
DE-B2- 2702557	79-02-08	FR-A-B-	2378282	78-08-18
		GB-A-	1574681	80-09-10
		JP-A-	53093684	78-08-16
		SE-A-	7800725	78-07-23
		US-A-	4187462	80-02-05
US-A- 3254527	66-06-07	FR-A-	1356034	00-00-00
		GB-A-	1036932	00-00-00